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BY THE U.S. GENERAL ACCOUNTING OFFICE

**Report To The Administrator, National Aeronautics And Space Administration**

ORIGINAL
COMPLETED

# NASA's Standard Parts Program-- Are The Objectives Being Accomplished?

In 1974 NASA initiated its Standard Parts Program to increase the availability of reliable electronic parts meeting the minimum requirements of its programs and projects, reduce overall costs to NASA by standardization, and eliminate duplication in parts control efforts among its field centers/installations and contractors.

While there has been notable progress recently in planning and implementing the program, improvements are needed in monitoring and evaluating the program, justifying the use of nonstandard parts, and developing and implementing policies and procedures to help assure maximum benefits from consolidated procurements of electronic parts.

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

PROCUREMENT AND SYSTEMS
ACQUISITION DIVISION

B-201475

The Honorable Robert A. Frosch
Administrator, National Aeronautics
and Space Administration

Dear Dr. Frosch:

We have completed a review of NASA's progress in implementing the Standard Parts Program and its efforts to consolidate procurements of electronic parts. While there has been notable progress recently in planning for and implementing the program, we believe that improvements are needed in (1) monitoring and evaluating the program, (2) justifying the use of nonstandard parts, and (3) developing and implementing policies and procedures to help assure that maximum benefits are achieved from consolidated procurements of electronic parts.

## SCOPE AND METHODOLOGY OF REVIEW

Our review was conducted primarily at NASA Headquarters, Washington, D.C.; the Marshall Space Flight Center (MSFC), Huntsville, Alabama; and the Goddard Space Flight Center (GSFC), Greenbelt, Maryland. We reviewed NASA's policies, procedures, practices, audit reports, studies, and other documents related to the establishment, implementation, and evaluation of the Standard Parts Program.

In addition to interviews and examination of records at NASA Headquarters, GSFC, and MSFC, we also obtained data and other information by questionnaire from other NASA centers/installations on electronic parts standardization and procurement matters. Questionnaires were sent to Ames Research Center, Langley Research Center, Lewis Research Center, Johnson Space Center, Kennedy Space Center, and the Jet Propulsion Laboratory (JPL). The portion of the questionnaire on parts procurement was also sent to GSFC and MSFC to, among other things, update their positions on the consolidated procurement issue. Johnson Space Center's response to our questionnaire did not specifically answer many of our questions and was not used in our study.

We visited and obtained information from five NASA contractors and discussed electronic parts standardization and procurement matters with industry associations, two private firms with an interest in consolidated procurement of electronic parts, four electronic parts manufacturers, and the Air Force Space Division.

The review results are discussed below and the details are summarized in appendix I.

## PROGRAM MANAGEMENT--ACTIONS TAKEN AND NEEDED

Key elements in the Standard Parts Program are the development of a mature standard parts list and the use of that list by NASA centers and contractors in the design of flight and essential ground support equipment. There has been progress since the program was established in 1974 in developing a mature standard parts list, although much remains to be done to improve the list and make it more usable. Since the first list was issued in 1976, its coverage has been substantially expanded and NASA is working to make more high reliability parts available. Future progress may be slowed, however, by a shortage of program funds.

Recent development of a plan which defines program objectives, work, schedules, and needed resources should contribute to better management. A major shortcoming, however, has been the lack of a formal system for monitoring and evaluating the program's effectiveness. Although annual evaluations were required by procedures established in 1974, no formal assessments have been made of the program's effectiveness. While planning has begun, a data collection system which measures standard and nonstandard parts usage on NASA projects has not yet been developed. Such data is needed to identify parts for standardization as well as to monitor parts usage on the projects. (See app. I, pp. 3 to 7.)

## USE OF STANDARD PARTS ON NASA PROJECTS

NASA centers and JPL, to varying degrees, have begun incorporating requirements for use of standard parts for many of their projects. Various factors inhibit the use of standard parts, such as (1) limited coverage of the standard parts list, (2) unique parts requirements and use of existing equipment and designs and related parts lists, (3) use of existing residual parts from prior programs, (4) designer objections to using Government specifications

and Government-qualified suppliers, (5) long delivery time for some standard parts and project schedule or funding limits which influence users to select more readily available or lower initial cost parts, and (6) acceptance, in some cases, of contractors' parts lists in lieu of the standard parts list.

Procedures established by NASA to help assure maximum use of standard parts require that each use of a nonstandard part be formally justified. This has not been done in some cases and, on some projects, the use of contractors' parts lists have been given preference over the standard parts list. We believe these practices can raise doubts about the strength of NASA's commitment to electronic parts standardization. Actions are needed to assure that the formal justification requirements related to using nonstandard parts are applied and effective. In the case of JPL, the Standard Parts Program is not applicable under the contract for operation of JPL, although it voluntarily participates in the program. (See app. I, pp. 7 to 13.)

## CONSOLIDATED PROCUREMENT OF ELECTRONIC PARTS

Consolidated procurement of electronic parts has been established as a goal of the program. On some projects NASA has realized benefits from volume buying of electronic parts with the attendant improvements in parts availability, quality, and reliability. However, policies and procedures to help assure that the benefits of consolidated procurements are maximized have not been developed or implemented.

Between 1975 and 1977 NASA studied the advantages and disadvantages of an agencywide consolidated procurement and stocking program to support the Standard Parts Program. The study group estimated a 10-year savings of $100 million in parts procurement costs and recommended that an agencywide program be implemented. Citing reduced funding for new starts, problems with an agencywide program, and other concerns, NASA decided in 1977 to encourage consolidated procurement of parts at the program or project level by the prime contractor rather than NASA-wide. However, policies and procedures to implement this decision have not been issued.

The proposed NASA policy could be of great benefit in achieving the goal of consolidated procurements of electronic parts where contractors are willing and able to assume the responsibility for consolidated procurements

and where the volume of parts needed on a project make this practical. The policy needs to be formalized and communicated effectively to NASA program managers and the field centers. Implementing guidelines should be issued and their use monitored to determine whether adequate consideration is given to consolidated procurement of electronic parts in planning new flight projects.

We believe that there will be many circumstances where an additional approach would be needed to maximize the benefits of consolidated procurement of electronic parts. Small space flight projects, projects where there are many contractors but none willing or able to perform the consolidated buying, and small in-house developments, for example, may not obtain the benefits of large volume buying. This should be further investigated through a test program of consolidated buying and stocking of standard parts. The objective of the test would be to provide the costs and benefits data and other information which would allow an informed judgment to be made about the best approach or combination of approaches to achieve maximum overall benefits from consolidated procurements in the future. (See app. I, pp. 13 to 18.)

## RECOMMENDATIONS

We recommend that the Administrator of NASA

--have the annual effectiveness evaluations of the Standard Parts Program performed addressing the (1) compliance of the field centers with requirements to adequately justify the use of nonstandard parts, (2) development of a system for collecting standard and nonstandard parts usage data, (3) the degree of standardization being achieved on projects, and (4) the adequacy of funds devoted to the program,

--issue policy and implementing guidelines for program or projectwide consolidated procurement of electronic parts and establish the needed mechanism to monitor and evaluate the action of NASA's managers in achieving consolidated procurements,

--investigate, on a test basis, a NASA-directed consolidated procurement and stocking program for projects or developments where program or projectwide consolidated procurements are not feasible, and

--amend the contract with JPL to formally include it in the Standard Parts Program.

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As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We discussed our findings with NASA Headquarters officials responsible for the Standard Parts Program and officials at MSFC and GSFC. Their comments and suggestions were considered in preparing this report. We appreciate the cooperation extended us during this review.

Sincerely yours,

W. H. Sheley, Jr.
Acting Director

## SUMMARY OF OUR REVIEW OF

## NASA'S STANDARD PARTS PROGRAM

### INTRODUCTION

NASA spends hundreds of millions of dollars each year developing space flight and associated hardware (launch vehicles, spacecraft, support equipment, and so forth). To accomplish its missions, NASA must assure that its equipment will perform satisfactorily. NASA's reliability and quality assurance activities are an important part of the overall process NASA uses to help avoid or minimize flight equipment failures and expensive rework and project schedule slippages.

As part of its reliability assurance activities, NASA imposes controls over the selection, procurement, and use of electronic parts on its flight and ground support hardware. In furtherance of its objectives to use reliable parts on its projects, in 1974 NASA initiated an agencywide standardization program for electronic parts. NASA Policy Directive (NPD 5320.5) established the Standard Parts Program. The program's objectives are to (1) increase the availability of reliable electronic parts meeting the minimum requirements of NASA programs and projects, (2) reduce overall costs to NASA by standardization, and (3) eliminate duplication in parts control efforts among its field centers/installations, prime contractors, and subcontractors.

The NASA policy directive noted that NASA projects had experienced continuing difficulty and increased costs due to electronic parts failures during ground tests with the consequent need to correct the problems after assembly of flight hardware. Because it is not possible to eliminate all parts failures by ground tests alone, some costly flight failures occurred which were caused by faulty parts. A common cause of parts failures, other than those due to poor application practices, was poor process control and workmanship by the parts manufacturer.

#### Why standardization is important

NASA's share of the Government market for electronic parts is small and fragmented, resulting generally in low-quantity parts procurements on its projects.

Electronic parts standardization is important to NASA to improve its position in the marketplace and to be able to procure high reliability parts for timely delivery at reasonable cost. The Standard Parts Program expects to

increase the quantities of standard electronic parts used by limiting the number of different types, sizes, and grades of parts used on NASA projects.

While the primary objective of the program was to increase the availability and use of reliable electronic parts meeting NASA's requirements, other benefits from standardization are interrelated and include

--being able to reduce the efforts of its various centers and installations in developing and maintaining individual preferred parts lists,

--reduced cost of NASA contractors in qualifying parts for use on NASA projects, and

--the potential benefits of consolidated buying of parts, thereby, reducing cost and improving quality through greater visibility and control of the parts supply.

NASA participation in the Department of Defense standardization and specification program

Recognizing the importance of and potential impact on cost and availability of parts and acceptability by industry of a single set of Government standards, NASA joined the Department of Defense as partners in the Defense Standardization and Specification Program. Through a participation agreement, the specification and standards development and parts qualification activities of the Department of Defense are used in the NASA Standard Parts Program.

The working agreement allows NASA to participate in a well recognized standardization program, thereby, eliminating duplicative program functions. Also, NASA works with the Air Force Space Division to develop joint space quality and reliability requirements for some commonly used electronic parts.

Program implementation and organization

At NASA Headquarters, the Program Assurance Division, under the NASA Chief Engineer, has the overall functional responsibility for reliability and quality assurance activities. This Division is responsible for developing policy and providing guidance, standards, and procedures. It also assesses reliability and quality assurance functions and activities throughout NASA to determine if they are performed in accordance with the policy and will accomplish NASA objectives.

Within the Program Assurance Division, a parts and materials manager is responsible for program planning, development, implementation, and other activities involved with high reliability parts and materials technologies. In addition to responsibilities for overall parts and materials reliability and quality assurance, he manages the NASA Standard Parts Program, providing direction to the MSFC Lead Center Office. He also is responsible for annual reviews of the Standard Parts Program's effectiveness.

MSFC was designated as the lead center for the centralized tasks for the program, such as determining the parts to be included on the standard parts list, selecting and/or developing the parts specifications, arranging for qualification by parts manufacturers, performing or arranging for necessary parts testing, and preparing and monitoring the list.

The NASA centers and installations (users) are responsible for implementing the NASA Standard Parts Program for in-house and contracted work. This includes selecting and using parts from the NASA standard parts list using the listed specifications for part purchase and control.

## NASA HEADQUARTERS AND LEAD CENTER OFFICE MANAGEMENT--ACTIONS TAKEN AND NEEDED TO STRENGTHEN THE STANDARD PARTS PROGRAM

There has been substantial progress in developing a mature standard parts list, although much remains to be done to make it more complete and improve its usefulness. Actions taken and planned by the Lead Center Office at MSFC should contribute to better overall program management. Future progress may be slowed, however, by the shortage of funds to devote to the Standard Parts Program.

A major shortcoming has been the lack of a formal system for monitoring and evaluating the Standard Parts Program to provide needed insight into the program's effectiveness.

### Lead center office's management--progress made and planned

In 1974 MSFC was designated the lead center for developing, maintaining, and otherwise supporting a NASA standard parts list for use by all NASA centers. Only recently has a project management plan been prepared by the Lead Center Office defining the work to be done and the resources required to accomplish the work within a prescribed time frame. The need for a project management plan and the lead center's

progress and difficulties in developing and maintaining a usable standard parts list are discussed below.

Planning and managing the lead center functions

NASA projects are generally undertaken on the basis of plans defining the work to be done and showing the tasks, resources, and schedules required to accomplish the project's objectives. The project plans generally define how management is to measure and assess their progress against approved objectives. The Lead Center Office initially did not define work tasks and milestones or the resources necessary to implement and operate the Standard Parts Program other than on a year-to-year basis. Also, the lead center has not developed criteria or procedures for assessing its effectiveness and no assessments have been completed.

To define objectives and the work and schedules required to accomplish these objectives, the Lead Center Office developed a project plan, dated December 1979, covering a 3-year period. This is the first long range plan developed by the office. The plan specifies the staffing and funding levels needed to carry out the plan and also specifies a standardization status report as a major output of the program.

The standardization status report will be prepared annually and will address such items as revisions to the standard parts list, usage of standard parts on NASA projects, availability of standard parts, production yield problems, specification and qualification status, and so forth. According to the Lead Center Office manager, this report will be the first such assessment made by that office.

Since its establishment in 1974, the Standard Parts Program has been funded at a conservative level. The program's budgets for Lead Center Office activities for the first 4 fiscal years were $450,000 each year while the budget for fiscal year 1979 was increased to $700,000. 1/ MSFC officials believe these budgets were generally adequate to support the program's implementation and early development.

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1/These are research and development funds budgeted for the Lead Center Office activities. Total funds available for support of the program will be higher.

However, since no approved plan existed defining the tasks required to be done and the program schedules, it is difficult to determine the adequacy of the budgets. For example, development of a parts application handbook, important for the support of the standard parts list, has been delayed because of lack of funds but the impact cannot be assessed.

The NASA Chief Engineer approved the basic concept of the Lead Center Office plan in March 1980. The plan had estimated fiscal year 1980 fund requirements at $1.6 million; however, only $700,000 was approved. The manager of the Standard Parts Program said that the main effect of the reduced funding was to delay parts testing for the program.

Standard parts list development--
data collection system needed

Two important functions of the lead center are selecting the parts for standardization and determining that the standard parts list is usable by NASA centers and projects. The Lead Center Office, under NASA Management Instruction 5320.6, was assigned responsibility for developing trend data on standard and nonstandard parts usage. A major purpose of developing trend data on parts usage is to identify parts being used on center programs and projects which make logical candidates for standardization based on high usage and commonality to NASA centers and programs. The data could also be used to monitor parts usage on NASA projects. Because a data collection system did not exist, the standard parts list has been developed from electronic parts lists supplied by its centers, JPL, and from some project parts lists, including the space shuttle.

The need for a data collection system has been recognized in the project plan recently developed by the Lead Center Office. At the time of our review the lead center had not developed the data collection system to be used. However, the lead center has planned a pilot data collection system which, if proven effective, will provide statistical data of standard/nonstandard parts usage.

Maturity of the standard parts
list and limitations on its use

The original standard parts list issued in January 1976 contained 5 part categories and over 2,300 parts. Revision A, dated August 1977, did not expand the part categories listed but did increase the number of parts listed. Revision B was released in October 1979 and contains over 5,000 part

specifications for an expanded 13 part categories. The Lead Center Office manager said that the standard parts list was not complete yet regarding either part categories or the number of parts listed.

In addition to the list's completeness, the usability of NASA's standard parts list has also been affected by a lack of certain grade 1 parts. The list contains two grades of parts suitable for use on NASA programs and projects. Grade 1 parts are intended for use in critical applications while grade 2 parts are for less critical applications. According to the Lead Center Office manager, it is important that grade 1 parts be listed for all part categories on the list. However, 8 of the 13 part categories contain no grade 1 parts. The Lead Center Office plans eventually to have grade 1 parts listed in these eight categories.

The Lead Center Office has not issued a standard parts application handbook to support the NASA standard parts list. A parts application handbook would aid design engineers in part selection and would provide guidelines on their use. The Lead Center Office manager said that the parts application handbook is important to the Standard Parts Program and that the lack of it has probably resulted in lower usage rates of standard parts on NASA projects. Low lead center budgets and higher priority given to developing the standard parts list delayed an early start of work on a parts application handbook.

Actions by Lead Center Office to improve usability of the standard parts list

Revision B to the standard parts list represents a major expansion of the standard parts list and is the first major revision to the list since its first publication in January 1976. According to the Lead Center Office manager, revision B represents a major step toward the goal of a complete list. Responses to our questionnaire from NASA centers and JPL showed that early editions of the list were not complete but that revision B did add significantly to the list.

Lead center plans call for the standard parts list to be revised annually, and a complete list is scheduled for release in fiscal year 1981. Another related step taken to increase standard parts usage was the award of a contract in September 1978 for development of a NASA standard parts application handbook and a standard parts catalog. The catalog was issued in April 1980, but as of October 1980 the application handbook had not been issued.

The Lead Center Office is also working with the Air Force Space Division and the Defense Electronics Supply Center to make more grade 1 parts available. This started with the joint development of NASA and Air Force Space Division requirements for grade 1 microcircuits, transistors, and diodes. Grade 1 requirements for other part categories are still being developed. NASA, the Air Force Space Division, and the Defense Electronics Supply Center have also developed grade 1 manufacturer part qualification requirements for microcircuits.

The Lead Center Office has also contracted with two firms to provide grade 1 qualification tests on radiation-hardened microcircuits. Also, it has listed screening guidelines in revision B to the standard parts list for upgrading grade 2 parts for use in grade 1 applications as an interim solution to the shortage of grade 1 parts and qualified suppliers.

## Monitoring and evaluating the Standard Parts Program

The manager of the Standard Parts Program is responsible for annually assessing the effectiveness of the program and reporting these assessments to the Deputy Administrator and other NASA managers. We found, however, that no formal assessments have been made on the overall effectiveness of the program since its inception in 1974.

The manager has visibility to some extent on the progress of the program, for example, through the manager's chairmanship of the NASA Parts Steering Committee, his participation in reliability and quality assurance surveys at the NASA centers and installations, and through progress reports from the Lead Center Office. While these mechanisms and others available to the manager would be primary sources for monitoring and evaluating the Standard Parts Program, data on usage of standard and nonstandard parts by NASA projects and an analysis of that data are also needed.

## USE OF STANDARD PARTS ON NASA PROJECTS--MORE EMPHASIS NEEDED

To varying degrees, NASA's centers and JPL have begun incorporating requirements to use NASA's standard parts list for many of their projects. The extent of standard parts usage on NASA projects, however, is not known because a system to collect and analyze such data has not been developed. Various factors inhibit the use of standard parts on NASA projects, including (1) limited coverage of the standard parts

list, (2) unique parts requirements and use of existing equipment components and designs and related parts lists, (3) use of existing residual flight-qualified parts from prior programs, (4) designer objections to use of Government specifications and Government-qualified suppliers, (5) long delivery time for some standard parts and/or project schedule or funding limits which influence users to select more readily available or lower initial cost parts, and (6) acceptance, in some cases, of contractors' parts lists in lieu of the standard parts list.

NASA centers and JPL have a variety of practices for exercising control over the selection of electronic parts. Requirements under the Standard Parts Program for formal waivers for use of nonstandard parts are not being applied in some cases by the NASA centers, and on some projects the use of contractors' parts lists are given preference over the NASA-wide standard parts list. We believe these practices can raise doubts about the strength of NASA's commitment to or emphasis on electronic parts standardization and should be reviewed and evaluated. Specifically, NASA needs to assure that the formal justification requirement is consistently applied and has the desired effect of properly justifying the use of nonstandard parts.

We found that the centers had required or specified the use of NASA's standard parts list in various ways on many of their projects. JPL reported that it had not imposed the requirement for use of the standard parts list on any of its projects. Implementation of the Standard Parts Program by JPL and GSFC is discussed in the following sections.

Requirement for use of standard parts and justifications for nonstandard parts

For part categories covered by the Standard Parts Program, NASA centers/installations are required by NASA Management Instruction 5320.6 to use parts from the standard parts list. That instruction covers both in-house and contracted effort involving flight hardware and mission-essential ground support equipment for new programs and projects. Off-the-shelf hardware qualified for its intended use is not covered by this instruction.

Waiver of the requirement for use of parts on the standard parts list is to be given only with the formal approval of each nonstandard part by a single central authority established by each NASA center/installation. Documentation of the waivers are to include details of the application of the nonstandard parts and the rationale for not using NASA

standard parts. These waiver requests are generally termed nonstandard parts approval requests (NSPARs).

JPL

JPL reported that the NASA Standard Parts Program is not formally applicable under the NASA contract for operation of JPL. NASA's standard parts list has not been imposed as a project requirement on any of JPL's flight projects. JPL has, however, incorporated the contents of the standard parts list within its own preferred parts list and supports the Standard Parts Program in other ways. JPL serves, for example, as the lead center for evaluation and qualification of certain microcircuit devices for the program.

JPL reported that (1) special requirements such as the need for radiation-hardened microcircuits, transistors, and diodes, (2) other special high reliability requirements, and (3) incompleteness of the standard parts list impeded the mandatory use of NASA standard parts on JPL flight projects. According to JPL, the expanded efforts of the Standard Parts Program should help alleviate the last problem.

NASA's standard parts list is fully contained within JPL's preferred parts list. For each JPL project, an approved parts list is developed primarily, but not exclusively, from the JPL preferred parts list. JPL considers any part as "nonstandard" if it does not appear on the approved project parts list, and it must have an approved waiver before the part can be used on the project. The waiver request must, among other things, justify why the nonstandard part cannot be replaced by a standard part.

GSFC

GSFC has specified the use of the standard parts list in various ways on several of its projects. Parts on the standard parts list are also included in the GSFC preferred parts list (PPL). PPL provides that the standard parts list is the prime reference document for preferred electronic parts. PPL complements the standard parts list by listing additional part types and categories not included in the standard parts list. However, where the two lists conflict, PPL takes precedence.

We examined the electronic parts requirements, parts lists, and related records and documents for major contracts on two GSFC projects--Landsat-D and Magsat. We discussed parts selection and related matters with GSFC and contractor officials. Because GSFC had recently conducted a reliability

and quality assurance audit on the Multimission Modular Spacecraft (MMS) which is used on the Landsat-D Program, we limited our work on MMS to a review of the GSFC audit reports and parts requirements and a discussion with the GSFC parts engineer for that project. The use of standard parts on these projects is summarized in the following sections.

Landsat-D Project

For unique equipment items on the flight segment of this project, electronic parts were required to be selected from GSFC's PPL, the standard parts list, or previous GSFC-approved NSPARs. Parts from these lists were considered standard, and formal NSPARs were required for all other parts. NSPARs were to be submitted by the contractor for GSFC review but did not require GSFC approvals. Some NSPARs had been submitted at the time of our review, but, according to the cognizant GSFC parts engineer, nearly half of these did not fully explain the difference between a standard part and the part proposed to be used. He also questioned the worth of requiring formal NSPARs because in many cases they are not adequately prepared and there is little time to review them and seek corrective action. In the case of a major subcontractor, GSFC and the prime contractor approved the use of the subcontractor's parts list as standard, thus limiting the NSPARs which had to be submitted.

There was a rather high degree of standardization on the unique equipment items when analyzed on the basis of part types selected. The contractor's analysis showed that 60 percent of the parts selected were types listed in GSFC's PPL. Based on procurement specifications, however, the extent of parts used from the standard parts list was about 30 percent.

Factors cited by the unique equipment contractor which limited the potential for use of standard parts included the

--design maturity of the equipment being developed (for example, some equipment used prior designs and parts used were from the prior programs),

--special packaging requirements and other unique parts requirements,

--limited scope of the NASA standard parts list or PPL, both as to part categories covered and parts needed for special or unique performance requirements, and

--program constraints (availability of the parts to meet the project schedule, use of existing company standardization/specification/procurement/stocking system, and so forth.)

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For the thematic mapper, a major new instrument to be used on the Landsat-D mission, the contractor's parts list was to be given priority for parts selection. Needed parts not on the contractor's parts list were to be selected from the standard parts list or GSFC's PPL. NSPARs were required to be submitted in some cases for GSFC's approval. At the time of our review, 130 NSPARs had been submitted to GSFC. Seventy-four were approved and 1 was disapproved. Most of the NSPARs did not show a comparison of the nonstandard parts with standard parts. The GSFC engineer said that these NSPARs were generally submitted too late for him to be concerned with standardization. His first priority was to review the quality requirements for the parts, including screening, materials, testing, and inspections made. However, GSFC has requested additional documentation on many of these parts.

The parts list for this instrument showed that only 6 percent of the parts selected were listed in GSFC's PPL. Most selected parts were listed on the contractor's approved parts selection guide. The contractor cited the extra screening and testing required by GSFC for parts on this instrument as well as unique requirements, in some cases, as reasons it was desirable to use the contractor's parts specifications rather than the standard parts list. Contractor officials also expressed concern over the quality of electronic parts available from some vendors listed on the Department of Defense's qualified products list.

GSFC's reliability and quality assurance audit of the MMS Project, among other things, included an examination of standard part selection and controls over nonstandard parts. This examination included the three major module contractors, a major subcontractor, and two contractors for standard components used on MMS. Parts requirements for the audited MMS module contractors and subcontractor were established by GSFC. The requirements for the standard components were established by JPL which was responsible for procuring these components.

With respect to the three MMS major module contractors, GSFC found that two had made a conscientious effort to design

with standard parts (as defined for the project) and commended their efforts at standardization. For one contractor, GSFC found it difficult to determine whether maximum effort was expended in specifying and procuring parts of the proper quality level.

A number of problems were found in the justification of nonstandard parts. For example, a lack of a clear understanding between GSFC and one contractor led the contractor to believe that NSPARs did not have to be submitted and NSPARs from another contractor were unresolved for long periods of time. According to GSFC officials, some NSPARs were never resolved.

While GSFC's review found that a major subcontractor had used an extraordinarily high percentage of standard parts, GSFC found problems with the parts selection by the two standard component contractors. These included such matters as:

--Lack of a clear definition of what constituted a standard part and how nonstandard parts were to be treated.

--Selection of "standard" parts by one contractor was good when judged against JPL-imposed requirements but would be less than 10 percent if judged against requirements GSFC imposed on the MMS Project.

--Selection of standard parts by one contractor was minimal and NSPARs, although contractually required, were verbally waived by JPL. Because of the lack of NSPARs submittals, GSFC could not determine if nonstandard parts were qualified or needed to be qualified.

Magsat Project

Electronic parts for the spacecraft were to be selected from various sources. First preference was to be given to parts on the standard parts list and GSFC's PPL. The contractor's parts list was to be third choice. NSPARs were to be submitted for GSFC approval only for some military specification parts and commercial parts not qualified by previous flight experience. There were 26 NSPARs submitted to GSFC. One was subsequently canceled and the others were approved.

Selection of parts from the standard parts list was minimal for the Magsat spacecraft. Several factors account for this, including the use of a high percentage of residual hardware items from a previous GSFC project. Contractor

officials also pointed out that in some cases (1) needed parts were either not on the standard parts list or not at the grade level needed or (2) if on the list, would not be available when needed. They also observed that the length of time it takes to get a part on the standard parts list detracted from the usefulness of the list.

Electronic parts for the scalar magnetometer were required to be selected from the standard parts list and GSFC's PPL. Parts other than from these lists were considered nonstandard. The contract gave GSFC only review and not approval authority for NSPARs. The contractor submitted 41 NSPARs, and GSFC responded with recommendations which were implemented when the contractor felt it was possible. About 38 percent of the part types and 58 percent of the part quantities used on the scalar magnetometer were on the standard parts list (for five categories then covered by the list).

For the vector magnetometer developed in-house at GSFC, the parts were to be selected from GSFC's PPL, the standard parts list, or an approved contractor's parts list. Nonstandard parts were defined as any not listed on GSFC's PPL. The parts list for this instrument did not sufficiently identify part specifications to allow an analysis of standard parts used. NSPARs were not prepared and, according to GSFC officials, are seldom prepared for in-house developments. GSFC officials said that NSPARs required too much time and money and they preferred other methods of reviewing nonstandard parts.

## CONSOLIDATED PROCUREMENT AND STOCKING OF ELECTRONIC PARTS--NEED FOR ACTIONS TO MAXIMIZE THE BENEFITS

Consolidated procurement of electronic parts was made a goal of the Standard Parts Program. On some projects NASA has recognized that volume buying of electronic parts through consolidated procurement can lower costs and help improve availability, reliability, and quality of the parts. While benefits of consolidated buying have been achieved on some of NASA's projects, NASA needs to develop and implement policies and procedures to help assure that benefits are maximized from consolidated buying.

### Experiences with consolidated procurement of electronic parts

Several NASA centers and JPL have used a consolidated procurement approach for electronic parts. In most cases

the consolidated buying was within a particular project. One notable exception was a procurement of microcircuits by GSFC involving requirements of several GSFC projects. Assessments of these efforts by NASA and others show that benefits resulted from consolidated buying and various problems were also encountered. Some examples are discussed below.

MSFC

The only consolidated procurement MSFC has tried was on the High Energy Astronomy Observatory (HEAO) Project. To help reduce program cost, MSFC implemented a consolidated procurement approach in February 1973 referred to as the HEAO Central Parts Control (CPC) Program.

Although used by the HEAO spacecraft contractor, the HEAO CPC Program was primarily established for the benefit of the experiment contractors because

--experiment contractors usually had very limited manpower assigned to electronic parts and

--the general condition of the electronic parts market made procurement of acceptable parts difficult and costly. (The commercial market was absorbing almost all electronic parts.)

MSFC's assessment of the HEAO CPC Program concluded that, overall, it was beneficial and provided the following major advantages:

--Savings of about $340,000 in quantity discounts on part procurements which would have cost about $2 million under a non-CPC approach.

--Improved parts visibility.

--Twenty-percent reduction in the number of different part line items.

--Centralized communication system.

--Reduced contract negotiation time.

--Fewer substandard parts.

--Standardization of part specifications.

--Improved procurement times for long-lead transistors and microcircuits.

MSFC's analysis showed that disadvantages of the CPC effort were that (1) contractors tended to lose incentive and rely more on MSFC for timely parts deliveries and (2) sometimes readily available commercial parts were procured instead of more reliable military specification parts.

GSFC

GSFC has used a consolidated procurement approach for electronic parts on some of its projects. For example, in 1974 GSFC decided to consolidate procurements of certain microcircuits because of reduced budgets and the problems of obtaining electronic parts of adequate quality and reliability at reasonable cost and delivery. A 1976 cost reduction report showed a savings in parts procurement under this contract of about $1.1 million from estimated parts procurements of $2.2 million under usual procurement practices. In addition to this cost savings, GSFC found that benefits of the common procurement included a reduction in leadtimes for delivery of the parts to users.

Langley Research Center

The Langley Research Center implemented a consolidated procurement approach on its Viking Lander Project. This procurement involved a consolidation of electronic parts procurements by the prime contractor for about 95 percent of the total parts required by the 18 contractors on this project.

According to NASA, the Viking experience showed that programwide consolidated procurement can contribute significantly to the goal of obtaining high reliability piece parts within cost and schedule constraints. The Langley Research Center believes that the Viking consolidated buying was an outstanding success. The Center found that the consolidated procurement saved several million dollars.

NASA study team recommends a NASA-wide program

In 1975 NASA Headquarters established a study team to investigate the feasibility of NASA-wide consolidated procurement and stocking of electronic parts. Based on the data and other information obtained, the study team proposed in September 1976 that a NASA-wide consolidated procurement and stocking program be implemented to support the NASA Standard Parts Program.

Most of the centers/installation directors stated that they supported the consolidated procurement concept as presented by headquarters, but that certain issues needed to be resolved. The main issues raised were related to Government-furnished property (GFP) liability, part obsolescence, resource availability, and whether NASA was committed to standardization. NASA's potential liability for late or defective parts was the greatest concern, particularly as it related to potential liability for cost and schedule changes due to parts failures or late parts deliveries. Delivery and/or performance problems could complicate contract management and contractors' incentive arrangements. To minimize the centers' concerns about the GFP issue, NASA's Program Assurance Division recommended that the procurement and stocking function be contracted out and that a NASA center manage the program. It believed this approach would interface the parts buyer directly with the user without involving potential liability to NASA.

The study team reported to the NASA Associate Administrator in July 1977 that its analysis indicated that a NASA-wide consolidated procurement program would save about $18 million during the first 5 years of operation, with a potential 10-year savings of $100 million. The report noted that the estimate included only direct savings in parts procurement 1/ and did not include the savings which might result from avoidance of schedule slippage associated with late parts deliveries. The study team concluded that NASA should move ahead as soon as possible on consolidated procurement and stocking.

The pros and cons of consolidated procurement

We sent a questionnaire to seven NASA centers and JPL to obtain their current views on the consolidated procurement issue. The Johnson Space Center did not respond to our specific questions on consolidated procurement; therefore, only seven responses were considered in our report.

Responses to our questionnaire showed that six NASA centers and JPL generally favored the concept of consolidated

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1/This analysis was built on various assumptions about the level of funding for new starts ($1.5 billion per year by 1981), standard parts usage, discounts for parts purchased in volume, a constant research and development budget for NASA, reduced funding requirements for the shuttle orbiter and main engine, and so forth.

buying and stocking of electronic parts. The responses, however, vary considerably on how and under what circumstances the consolidated procurements should be done. There are still major concerns by the centers and JPL over potential problems such as the GFP issue. For example, while acknowledging the merits of the concept, JPL thought that development of a NASA policy to assure maximum savings is worthy of much more study.

MSFC was of the opinion that, if consolidated procurement is to be implemented, it should be at the project level until problems (GFP, part obsolesence, and so forth) are resolved and more new project starts are authorized.

GSFC said that a consolidated procurement program could meet its needs if it were administered as a combined centerwide and projectwide activity. Specifically, the centerwide approach was desired for in-house projects and a projectwide approach for out-of-house flight projects where the major project contractor would accomplish the consolidated procurement. GSFC noted several potential problems with consolidated procurement, some of which it considered symptomatic of inherent drawbacks in consolidated buying and not unique to a particular project.

--There is an unnecessary risk to the Government by furnishing parts as GFP to contractors.

--Buying an inventory of parts involves speculation and can result in excess parts which could exceed their shelf life (requiring retesting, reprocurement, and so forth).

--Coordinating the parts requirements on different projects is difficult. Projects are not approved in parallel, which inhibits the ability to merge parts requirements of different projects for a consolidated procurement.

Decision to encourage consolidated procurement at program or project level rather than NASA-wide

Responding to a question from a Senate subcommittee 1/ at the fiscal year 1980 hearings, NASA replied that it had

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1/Senate Subcommittee on HUD-Independent Agencies, Committee on Appropriations.

decided in the latter part of fiscal year 1977 to encourage consolidated procurement at the program/project level rather than NASA-wide. NASA cited the following factors as influencing its decision.

--The dollars available for fiscal year 1977 new starts were lower than expected, and it appeared that funding for new starts would level out in future years at $500 million to $600 million rather than the $1.5 billion postulated in the study by the Program Assurance Division. No new starts were approved for fiscal year 1980, and NASA estimated that only $410 million would be available for 1977-79 starts during fiscal year 1980.

--The Air Force (Space Division) was more inclined to consider having the consolidating and procuring of parts done by the program prime contractors. A policy to this effect was issued by the Space Division in April 1978.

--Consolidated procurement on a program basis proved to be economical and did not have many of the undesirable features of a NASA-wide consolidated procurement.

NASA also cited the administrative problems of estimating future parts types usage, risk of large obsolete parts inventory, and impact of GFP failures on contract incentives as added factors in its decision.

The manager of the Standard Parts Program said that nothing formal had yet been done to encourage consolidated procurement of electronic parts. He said that parts guidelines, including those related to consolidated procurement, would be issued in the future. He did point out that the Office of the Chief Engineer had issued an experience bulletin in 1977 on the Viking Lander Piece Parts Program showing lessons learned from programwide consolidated procurement.

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